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Benjamin Count Rumford

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MEDICAL SOCIETY
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THE LONDON MEDICAL
THE REPORT
MADE TO THE
NATIONAL INSTITUTE OF FRANCE,
IN THE

MONTH OF DECEMBER, 1799,

BY

CITIZENS PORTAL, PELLETAN, FOURCROY, CHAPTAL, AND
VAUQUELIN,

RESPECTING THE

ARTIFICIAL MINERAL WATERS

PREPARED AT PARIS

By *NICHOLAS PAUL, & Co.*

WITH

EXTRACTS FROM THE REPORTS OF THE SOCIETY OF
PHYSICIANS OF PARIS,

AND

THE FACULTY OF GENEVA;

AND

OTHER TESTIMONIES IN FAVOUR OF THE SAME WATERS:

TO WHICH ARE ADDED,

SOME NOTES AND OBSERVATIONS,

By N. PAUL.

TRANSLATED FROM THE FRENCH.

LONDON:

PRINTED FOR N. PAUL,

BY G. WOODFALL, NO. 22, PATERNOSTER-ROW.

Sold by J. SEWELL, Cornhill; THOMAS BOOSEY, Old Broad Street;
H. D. SYMONDS, Paternoster-row, and J. CALLOW, Crown
Court, Soho.

1802.



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TO

BENJAMIN COUNT OF RUMFORD.

TO diminish the wants, and increase the comforts of Mankind, is surely one of the noblest purposes of Philosophy. This, Sir, has ever been the object of your labours. You have descended from the sublimest investigations of Physical Science, to the humble task of bringing your discoveries to the level of vulgar comprehension ; and (still more to insure their benefit to Society) you have condescended to instruct the Artist and the Workman in those particulars, which are necessary to their practical application.

Confident of the interest you take in every thing that relates to the benefit of Mankind, I venture to claim your Patronage to an undertaking which has for its
object

DEDICATION.

object a concern equally important and universal, the Preservation of Health, and the Relief of Disease. It is to no fanciful untried scheme, Sir, that I solicit your attention, but to an extensive and useful improvement of Chemical Discoveries, which had their rise in England, and which by unceasing efforts, and by the liberal support of enlightened men, I have happily succeeded in bringing to a greater degree of maturity in a foreign country.

Many years have elapsed, since I first engaged in a manufacture of Artificial Mineral Waters at Geneva. The distinguished approbation which that undertaking met with from the Physicians of that Place, and from the public at large, induced me to form another, and still more extensive one, of the same kind, at Paris. This, Sir, you have, not long ago, been pleased to visit; and the annexed Reports respecting it, which are drawn up by Committees selected from amongst the ablest Chemists and Physicians in France, will concur with your testimony to show that its claims to encouragement are not founded upon mysterious secrecy or specious pretence, but

DEDICATION.

rest upon the firm basis of scientific examination and approved use.

The characteristic liberality of the British Nation, entitles it, in an eminent degree, to share in the advantages of whatever is calculated for the good of Society; but it has a peculiar claim to benefits derived from the application of discoveries which originated from itself. Under your auspices, then, I cheerfully submit the matter to the test of public trial; and cannot doubt but the result will correspond with that countenance and favour, which you have been pleased to bestow upon the labours of,

SIR,

Your most obedient, and
very humble Servant,

Ns. PAUL.

W. J. Villier's Street, Strand
10th of April, 1802. }

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PREFACE.

P R E F A C E.

HAVING been strongly encouraged, by some friends in this country, to establish in London a laboratory, or manufacture of artificial mineral waters, upon the new plan, and with the several improvements which I have introduced abroad into that department of practical chemistry, I have lately repaired to England for that purpose. And although not quite a stranger in this City, where I resided for about fifteen months at a former period, I thought my first care ought to be to convey to the public an idea of my object, and of what I consider as my claims to its support. In this view I have been induced to publish the annexed REPORT made to the NATIONAL INSTITUTE of France by a select committee of eminent medical men and chemists, respecting the manufacture of mineral waters and the bathing establishment, which, within these two years, I have set on foot at Paris. This Re-

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port,

port, I have reason to suppose, will attract the public attention more effectually than any account or commentary of my own. It will show that not only physicians and men of science abroad have thought it worthy of their attention to inquire minutely into this establishment, but that it has, in some degree, become in France an object of public concern.

To this Report I have only subjoined, in the form of an Appendix, a few Notes, the principal of which contain testimonies from the Faculty of Paris, and from the Physicians of Geneva. To the latter especially, who have never ceased to give me all possible encouragement and assistance, I feel great pleasure in expressing upon this, as upon every occasion, my gratitude and regard.

Being myself a native of Geneva, and instructed early in life in some practical branches of mechanics, I often enjoyed the invaluable advantage of exercising my industry under the eyes and immediate direction of the late celebrated Professor de Sauffure, and of his worthy successor, the present Professor Pictet, who has never ceased to honour me with his friendship, and to assist me with his advice in all my undertakings. It is not
surprising

surprising, if, under such circumstances, I felt a strong desire to become acquainted with the elements of Chemistry and Natural Philosophy, and endeavoured to apply to some useful practical purpose, the gradual progress which I made in the study of those sciences. Amongst my first attempts of this kind, the imitation of mineral waters occupied the greatest portion of my time and attention. In conjunction with two other gentlemen of Geneva, and with the assistance and enlightened support of the Physicians of that Town, I soon met with very encouraging success; and although my attention has at no time been exclusively confined to this particular pursuit, yet I have ever since been endeavouring to bring these first attempts to a greater degree of utility and perfection.

My intention, at present, is to confine myself to the preparation of all such kinds of mineral waters as are either taken medicinally, or drank as a luxury, and as a salubrious article of diet, laying aside the bathing establishment, and all that relates to the *external* use of mineral waters. But the apparatus and laboratory are equally calculated to prepare any kind, or any quantities of

mineral waters, that may be required for any purpose whatever.

The public will now be constantly and regularly supplied with any of the mineral waters that are mentioned in the annexed Reports, and with such other kinds, or such new modifications of those waters, as Physicians may think proper to suggest.

The mineral waters that will be kept immediately in readiness are :

1. The STRONG SELTZER WATER.
2. The MILD SELTZER WATER *.
3. The STRONG SPA WATER.
4. The WEAK SPA WATER.
5. The GASEOUS ALKALINE WATER (commonly called *mephitic*) either with carbonate of soda or carbonate of pot-ash.
6. The SEIDLITZ WATER.
7. The OXYGENATED WATER.
8. The HYDRO-CARBONATED WATER.
9. The HYDRO-SULPHURATED OR HEPATIC WATER.

These

* The epithets STRONG and MILD, or STRONG and WEAK, which have been arbitrarily used in the Report, for want of more appropriate

These waters, in general, will be prepared according to the analysis mentioned in the annexed Report. But whenever it shall appear proper to make any changes or additions to the *formulae* now employed, such alterations will be made known to the public. It is impossible, indeed, to have any fixed and constant standard in the application of medicinal powers, the effects of which must always be influenced by the differences of climate, of constitution, and, above all, by the vast variety of diseases to which they are applied. Although I am far from claiming any pretensions to medical knowledge, and make a point on the contrary to submit, upon every occasion, my opinions to the experience of medical men, I can easily conceive that this class of medicines may be varied almost indefinitely. It may be found, for instance, that the Spa and Seidlitz water, mixed together, make an useful tonic purgative; or, that the Spa water

appropriate names, to contrast these two varieties of Seltzer Waters, cannot be considered as strictly applicable to their real nature, since the difference between them lies in the *QUALITY* rather than in the *QUANTITY* of the gas which they contain. This important difference will be found pointed out, and explained, in several parts of the Report. See pages 23 and 32.

may

may with advantage be mixed with the hydro-sulphurated water. Perhaps, also, the Seltzer water, blended with Seidlitz water, may be found preferable to that of Cheltenham; and, in short, innumerable combinations can be obtained, by artificial means, that may be more effectual in particular cases than those which Nature affords.

With regard to the *names* that are used to distinguish the different kinds of mineral waters, it must be confessed, that a degree of confusion cannot fail to arise from the deficiency of language in that respect. A variety of names have been arbitrarily introduced in the nomenclature of artificial mineral waters, which by no means always convey an idea of their composition. I shall not scruple, therefore, to adopt, for those that are altogether artificial compounds, such names as may appear more analogous to their real nature; but, in the imitation of natural waters, I wish to preserve, as much as possible, the names of the natural springs which it is intended to imitate. It is scarcely necessary to add, that I shall have no kind of objection, whenever it may be thought proper, to substitute occasionally, for the foreign artificial chalybeate, purgative, or hepatic waters,

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those

those of Tunbridge, Cheltenham, Bristol, Bath, or Harrowgate, with their full proportion of gaseous contents, according to the most accurate analysis which we have of these waters, and which Dr. Saunders, in his late treatise on mineral waters, has collected with great care and perspicuity.

With regard to the commercial part of this establishment, and all that relates to the sale of the waters, I beg leave to decline entering at present into any particulars on this subject. Notice of these particulars will be given to the public, from time to time, with an account of the different kinds of waters that will be kept in readiness, and of the alterations which may occasionally take place. I shall only observe, with respect to the æconomical part of this business, that a long experience, and careful comparison of results, have induced me to prefer glass bottles, notwithstanding their higher price, to the earthen ones commonly used for that purpose. My reason for this preference is, that the earthen bottles, from their porous texture, are apt to let a quantity of gas escape. I have experienced, on the contrary, that mineral waters could, with proper precautions, be transported in glass bottles to the distance of
three

three or four hundred miles by land, and could bear a voyage to the East and West Indies, or indeed any voyage whatever, without being in the least injured. And besides, the transparency of glass has the additional advantage of affording an easy and certain means of ascertaining their perfect cleanliness. In compliance, however, with the received custom, both kinds of bottles will be used, and the public will have its choice of either.

I do not know how far the use of mineral waters has been introduced into the hospitals of this country; but I conceive that they may, in some instances, supersede the use of wine or other expensive articles. I shall be happy, if this should be found to be the case, to supply public charitable Institutions, on any terms that their general welfare may be thought to require.

R E P O R T,

&c. &c.

SECTION I.

Object of the Report:—Short account of the attempts hitherto made for the preparation of Artificial Mineral Waters.

IN the year 1755, M. Venel of Montpellier, presented to the Royal Academy of Sciences, an account of his success in imitating Seltzer water, by passing through pure water the gas arising from effervescing substances. Chemists then, for the first time, began to conceive the hope of producing, by artificial means, mineral waters, exactly resembling those of Nature; and the prejudice before entertained, of its being impossible to communicate to simple water the same principles and the same virtues, that are found in natural mineral waters, gradually disappeared. M. Venel, indeed, considered this gas as nothing more than common condensable air; but, notwithstanding

B his

his error respecting the nature of such waters, still his process was the first decisive step towards their successful imitation. Soon after this, however, Dr. Black's discovery respecting fixed air, or (as it is now termed) carbonic acid, and the successive discoveries of Dr. Priestley, the Duke de Chaulnes, and M. Ruelle, on the solution of this new æriform acid in water, brought to light the true composition of spirituous or acidulous waters, and afforded the means of imitating them perfectly. The knowledge which was at the same time accumulated from all hands, respecting the various salts dissolved in water; the manner of detecting them with certainty, and extracting them without alteration; the solubility of iron by the assistance of the carbonic acid; and that of the fetid or hepatic gas (sulphurated hydrogen) in water, furnished the means of composing from their respective ingredients, artificial waters, in the several classes of acidulous, alkaline, bitter saline, simple and acidulous chalybeate waters, and likewise sulphureous waters; of all which, science had already shewn the important distinctions. Bergman was the first, who, in his valuable dissertations, published in 1774, 1775, and 1778, on the preparation of cold waters, on the aerial acid, and on the analysis of waters in general, gave easy processes of imitating, from their scrupulous examination, the waters of Scidchut, Seltzer, Spa, and Pyrmont; and also the hot and cold hepatic, or sulphureous waters. He shewed

shewed that no mineral water could be considered as exactly analysed, unless it could be imitated in all its properties, by dissolving in simple water the same principles that had been obtained from the compounded one; and he proved, that there was no exception to this general rule. Lastly, after having pointed out the advantages which Sweden, in particular, might derive from the artificial preparation of the above mentioned waters, as well with respect to its commerce, as to its indigent sick, and also to the advancement of the healing art, he gives some observations on the good effects of these factitious waters, which he had often found even superior to the natural ones in hæmorrhoidal affections, in arthritic pains, and in obstinate intermitting fevers. Thus did the illustrious Swedish professor leave far behind him all the imperfect essays which had been given before that period, and the vague or conjectural theories that had been offered respecting the analysis of waters.

In the year 1779, M. Duchanoy published a treatise on the art of preparing artificial mineral waters, in which the modes of imitating them were detailed at greater length, but with very little information that was new, or different from what had been given before by Bergman. In this treatise, however, the author offered the first entire and systematic view of the artificial preparation of most of the mineral waters in use, according to the

principles of an art, which, not twenty years before, had been deemed impossible.

Thus was the imitation of mineral waters not only invented, but almost immediately carried to perfection, in the interval between the middle of the century and the year 1780; that glorious æra of chemical labours and discoveries, in which the science underwent a complete change in France, and was built as it were upon a new foundation.

From that time, (1780) the art of imitating mineral waters has been continually improving; all the systematic works in Chemistry, as well as the numerous treatises on this subject in particular, presenting facts and results, which have carried this part of the science to a degree of perfection that leaves us scarcely any thing more to wish for.

It may therefore be said, that the art of imitating mineral waters is now carried to its utmost limits; and that Chemists well acquainted with the resources of their art, and skilful in their operations, will no longer find any difficulty in the preparation of them. Accordingly, for these twenty years past, the Chemists engaged in this department of their business, have satisfied the wishes of all physicians, who were sufficiently acquainted with chemical science, to put due trust in it, and to be convinced, that it has at last discovered the process of nature. In several well conducted laboratories of this kind, the waters of

Seltzer, Seidlitz, Spa, Balarue, and Barege, are now prepared; they are also made either stronger or weaker than those which nature affords, and their mildness or strength thus regulated to the degree which the views of the physician require.

But, besides that, either from local circumstances, or from the inadequate capital of those engaged, the business could not be carried on every where with the same facility and perfection, such an undertaking could never have attained that extent in the variety or magnitude of its operations, that enables it to supercede the use of the natural mineral waters, and to supply the demands of a large and populous city, if men equally conversant with the chemical and mechanical science necessary to ensure success, had not conceived and executed the plan of establishing genuine manufactures of artificial mineral waters upon an extensive scale. Among the establishments of this kind lately begun in France, that which Messrs. Paul and Co. have just set on foot, in the street of Mont-Martre, in Paris, deserves to be particularly distinguished*.

M. Paul, who, being at first connected with Mr. Goffe, an ingenious apothecary of Geneva, has for ten years past prepared mineral waters with great success at that place, and sold annually up-

* This establishment has since been removed to the street of Lazarre, near Tivoli,

wards of forty thousand bottles of artificial Seltzer water, presented to the National Institute, at its sitting of the 16th November, a paper on the preparation of mineral waters, the substance of which the Reporters will now proceed to state; they will afterwards describe the ingenious processes which they have seen employed in his laboratory, and give an account of the artificial waters themselves; they will then add some observations on their nature and comparative properties, and suggest certain improvements of which they appear to be still susceptible. Lastly, the Report will terminate with a statement of the results which the preceding facts have afforded, and of the conclusions which the Committee wish to lay before the Institute for its consideration.

SECTION II.

Abstract of the Memoir of Messrs. Paul and Co.

THE first part of this paper contains an account of the advantages which Geneva has, for ten years past, derived from the manufacture of artificial mineral waters*. The simple imitation of those waters, to which M. Paul first confined himself, has been followed by certain modifications suggested to him

* See Appendix, Note A.

by the physicians of that place; and especially by the preparation of gaseous waters, more highly impregnated than those of Nature. The establishment then, may be considered, both from its magnitude, and from the variety of mineral waters produced at it, as a real pneumatic laboratory. There are scarcely any mineral waters now imported into Geneva, whilst those of his manufacture are exported to the amount of forty or fifty thousand bottles annually. The success of this first attempt, has induced him to form a similar establishment at Paris. In this, are prepared nine kinds of artificial waters. The summary remarks that have hitherto been made upon each of these waters, are contained under the following heads:

1. The Seltzer Waters have been used with advantage in catarrhs, rheumatism, asthma, and in bilious and putrid disorders;—they prove diuretic and antiseptic, even when externally employed;—they are serviceable in spasmodic affections of the stomach; and they promote digestion. They may be taken mixed with milk, with wine, or with syrup of capillaire. M. Paul prepares them in two different ways: in the one, the carbonic acid (or fixed air) is disengaged from chalk by sulphuric (vitriolic) acid; in the other, it is separated from the same substance by heat alone. The water prepared in the former mode has somewhat of a sharp taste and irritating quality, owing to a small portion of the sulphuric acid carried over with

with the carbonic gas; but when prepared in the other, it is quite free from such impregnation, and therefore better adapted to those complaints in which irritation is to be avoided. With the carbonic acid gas, obtained in either of these modes, he likewise manufactures Seltzer water, either strong or weak, according to the proportion of gas introduced.

2. The waters of Spa, which like those of Seltz, are charged with a large proportion of carbonic acid, are, however, distinguished from the latter by containing iron. To the properties of the Seltzer water, therefore, they unite the tonic and stomachic qualities which this metal is known to possess.

3. The gaseous alkaline water, so highly commended in England, in cases of gravel and stone, certainly affords very great relief to the pain which accompanies these complaints; and, according to the authors of the Memoir under consideration, this effect must be attributed to the solvent power which this water imparts to the urine: they, therefore, think it proper to be employed instead of the caustic alkali, and Stephens's medicine. Patients should drink, every morning, two or three tumblers of this water, mixed with milk*.

4. The Seidlitz waters are the most easily imitated of any; and the artificial ones have exactly
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* Vide Dr. Saunder's Letter to Dr. Percival, in his Philosophical, Medical, and Experimental Essays, vol. 3d, 1776.

the same cooling and purgative qualities, which are observed in those that are produced by Nature.

5 The oxygenated waters, which contain nearly half their bulk of oxygen gas, and were first prepared by M. Paul, on the suggestion of the Physicians of Geneva, have perfectly answered the expectations formed of them, and deserve the greatest attention from medical men. Although possessed of no particular taste or smell, they restore appetite and strength, promote urine, restore the menstrual discharge, and relieve spasms of the stomach, and hysterical complaints. The *Bibliothèque Britannique* contains a series of interesting observations on their salutary effects.*

6. The hydrogenated waters contain about one-third their bulk of hydrogen gas (inflammable air). They are useful in fevers with inflammatory symptoms, in which they diminish the frequency of the pulse: they likewise allay pains in the urinary passages, promote sleep, and give relief in some nervous complaints.

7. The hydrocarbonated waters (those impregnated with a mixture of inflammable and fixed air) do not differ materially from the preceding.

8. The hydrosulphureous waters, prepared with hydrogen gas, mixed with a small proportion of hepatic or hydrosulphureous gas, have the taste and smell of rotten eggs, and resemble the natural

* See the Appendix, note B.

fulphureous waters. They are diaphoretic and discutient; very useful in obstructions, in jaundice, and in affections of the mesentery. They admit of many varieties, according to the proportions in which the two gases are employed; and their external application is equally worthy of attention. From the great quantity of sulphurated hydrogen gas with which they are charged, they become valuable as a lotion or bath in various foulnesses of the skin; and when applied in a stream (*douche*) upon the part, they have proved successful in curing ill-conditioned ulcers. They very advantageously supply the place of the natural sulphureous waters, to those patients whose circumstances will not permit their undertaking expensive journies for that purpose.

The author of the Memoir in question, concludes it with two observations, equally important. The first is æconomical, and has for its object, the advantage of not only keeping at home the money which used to be sent out of France, for the purchase of these waters; but of producing an influx of money for the same purpose from other countries. The other relates to the benefits which science will probably derive from the processes employed in this establishment for the preparation of mineral waters. Such is the substance of the Memoir presented by M. Paul to the Institute; and the whole is written with that simplicity and precision which correspond with the nature of the subject.

SECTION

SECTION III.

Processes used by Messrs. Paul and Co. in preparing the Artificial Waters;—Description of the Place in which the Business is carried on;—Proportions of the several Ingredients employed.

THE Committee, on the invitation of Messrs. Paul and Co. went to the laboratory, where the waters are prepared. They were immediately struck with the simplicity of the apparatus; with the order that prevailed in their respective arrangement; the ingenious means employed for procuring water, and for filtrating it between the first reservoir and that from which it is taken when about to be mineralized. They were not less gratified with the perfection of the machines for obtaining the gases, and particularly that for obtaining the carbonic acid from carbonate of lime (chalk), either by heat, or by the addition of sulphuric (vitriolic) acid; but they admired, above all, the rapid mechanism by means of which the gases are compressed, and condensed in the water that is to receive them. Throughout the whole the Committee have seen the most ingenious mechanical contrivances united to the greatest chemical accuracy. They were every where struck

with the difference between operations of this kind, when conducted on this large scale, and the little, not to say insignificant mode, in which they are usually carried on. The apparatus, which the Committee will now proceed to describe, is so disposed in this laboratory as to prepare at once several hundred pints of mineral waters, and to impregnate them in the strongest and most uniform manner.

The inventor of these processes is so perfectly acquainted with all the apparatus employed in the French laboratories for investigating the nature and use of elastic fluids; and has exerted so much ingenuity and precision in constructing his machines, that they might be considered as intended for chemical experiments of the most accurate kind. As the inventor, however, wishes to reserve to himself, and his partners, the complete knowledge of his apparatus, and especially of that employed to compress the gases (with which even the Committee were not made acquainted), it is not intended to enter into a minute description of it. The Committee, however, think it their duty to give at least a general notion of the processes employed, that the Institute may be enabled to appreciate the careful and enlightened management which presides over this important establishment. Enough will be said to convey an idea of the merits and advantages of this manufacture, but not to furnish the means of imitating it; and the Committee will thus have fulfilled the task assigned

assigned to them respecting the results of these processes, without infringing the rights of the inventor with regard to the machinery by which they are performed.

Two sorts of apparatus, equally simple and ingenious, and carried to a degree of perfection which may render them very useful, even in accurate experiments, are employed, the one for disengaging the gases by heat, the other by effervescence. The first is a metallic cylinder, which passes through a furnace, and is provided at each extremity with contrivances that enable the operator to see what is going on within it at any time, during the process; and also to collect, transfer, measure, and purify the gases thus separated. In short, this apparatus exhibits an assemblage of all the most exact and useful contrivances furnished by modern chemistry, for obtaining and examining elastic fluids.

From the extremity of this apparatus, (which is divided by a partition, and has on one side the furnace and cylinder, on the other, the receivers, and whatever else is necessary to the collecting, measuring, and purifying gases), there arise moveable tubes that can be lengthened, shortened, and directed at pleasure, so as to convey the gases into a pump, by which they are forced into strong close casks, where they meet with the filtered water, as it issues from a contiguous apparatus, and are dissolved in it by the joint assistance of agitation and
1
pressure.

pressure. This apparatus is applied to the condensation of the carbonic acid, and likewise to that of the oxygen and hydrogen gases.

The second kind of apparatus is appropriated to the obtaining elastic fluids by effervescence, and is still more simple than the former. Although it resembles those used in our laboratories, and consists of a receiver furnished with tubes, and stop-cocks, yet M. Paul has brought it to a degree of perfection, simplicity, and convenience, which renders the operation more easy, expeditious and certain, than before. Its performance is so exact, that nothing whatever is wasted: it collects the whole of the gas; and is so contrived, that the effervescing materials can never swell so much as to reach the first water through which the gas passes: in short, every thing relating to it, whether respecting time or space, is turned to the greatest advantage. The mechanism, which produces these effects, is at the same time of wonderful simplicity; and such as denotes in the inventor the most perfect experience in the several operations, as well as a complete acquaintance with the acknowledged inconveniencies attending the machines in common use, and with the means of obviating them. The gas furnished by this process, is drawn out by the same pump, and conveyed into the same casks as that which is expelled by heat.

With regard to the compressing machine, (the structure of which was not explained to the Committee,

mittee, as the inventor wishes to keep it secret) it is sufficient for us to say, that it answers the purpose in the most effectual manner; as the various gaseous waters, specimens of which were prepared before the Committee, contain a larger proportion of elastic fluids (especially of those that are known not to be soluble in water, except by the assistance of pressure) than any that have been made hitherto. The Committee saw him prepare in less than two hours, two small casks of Seltzer water, as well with the carbonic acid expelled by heat, as with the same gas disengaged by means of the sulphuric acid. This process is so simple in all its parts, as to be attended with no difficulty, irregularity, or loss of time: the greatest neatness prevails throughout the whole of the operation. The saline and other fixed matters that enter into the composition of some of these waters, and especially those of Seltz, Seidlitz, Spa, &c. are put in their due quantities, well mixed and powdered, into each bottle, before it is filled with the gaseous water, which is drawn immediately from the cask where it receives the impregnation. Even the mode of drawing off the gaseous water from these casks is brought to the highest degree of improvement. The hissing noise, and the bursting of the bottles occasionally, at the moment they are corked, convinces the spectator, that the water is super-saturated with gas; and, that, notwithstanding a small quantity escapes, the liquid still retains much

much more of it than any artificial water hitherto prepared.

To this sketch of the new processes which M. Paul employs for the solution of gases in water, the Committee think it proper to add a short account of the various ingredients which enter into the several mineral waters prepared by him; in order that physicians may thereby be enabled to direct their use according to the principles contained in them, or to suggest such modifications, in their preparation, as they may think desirable*. The following are the proportions, which, according to the written statement of M. Paul, to the Committee, are contained in each bottle of twenty ounces measure.

1st, The **STRONG SELTZER WATER** contains, in each bottle of 20 ounces,

Carbonic acid obtained by effervescence, 5 times the bulk of the water employed.

Carbonate of Lime, 4 grains

Magnesia, 2 grs.

Carbonate of Soda, 4 grs.

Muriate of Soda, 22 grs.

2dly, The **MILD SELTZER WATER** contains

Carbonic acid evolved by means of heat, and mixed with a little hydrogen gas, 4 times its bulk.

* See the Appendix, Note C.

The 4 falts in the same proportions as in the *strong* Seltzer water.

3dly, The SPA WATER contains, in each bottle of 20 ounces :

Carbonic acid obtained by effervescence, 5 times its volume.

Carbonate of Lime, 2 grains

Magnesia, 4 grs.

Carbonate of Soda, 2 grs.

Muriate of Soda, $\frac{1}{3}$ gr.

Carbonate of Iron, $\frac{1}{2}$ gr.

4thly, The STRONG SPA WATER contains :

The same as the preceding, but with a double proportion of iron.

5thly, The GASEOUS ALKALINE WATER contains :

Carbonic acid by effervescence, 6 times its volume.

Carbonate of Pot-ash, . . . 144 grains

6thly, The SEIDLITZ WATER contains :

Carbonic acid by effervescence, 5 times its volume.

Sulphate of Magnesia, . . . 144 grains

7thly, The OXYGENATED WATER contains :

Oxygen gas half its volume.

8thly, HYDROGENATED WATER contains:
Hydrogen gas, one third of its volume.

9thly, HYDRO-CARBONATED WATER contains:
Carbonated hydrogen gas, two-thirds of its
volume.

10thly, The WEAK HYDRO-SULPHURATED
WATER contains:

Half its volume of hydrogen gas, mixed
with one-thirtieth part of sulphurated
hydrogen gas.

11thly, The STRONG HYDRO-SULPHURATED
WATER contains:

Half its volume of hydrogen gas, mixed with
one-fourth of sulphurated hydrogen gas.

SECTION IV.

*Examination of the Waters prepared in the
Establishment of Messrs. Paul and Co.*

THE Committee did not confine its enquiry to the inspection of the laboratory of mineral waters, and the processes of fabrication; they thought it proper to bring the results themselves under examination. For that purpose, a few bottles of each of the waters, prepared by the above mentioned processes, were carried, carefully corked
and

and sealed up, from the laboratory of Messrs. Paul and Co. to that of one of the members of the Committee, where they were examined, not with all the accuracy required in the analysis of an unknown mineral water, (as such a precision would have been superfluous), but with sufficient care and attention, to give perfect satisfaction as to the nature of their contents. The following circumstances were observed by the Committee, three days after the bottles had been in their possession, during which time they were kept in a cool and shaded place.

The bottles containing Seltzer water, especially that which M. Paul calls *Strong Seltzer water*, produced at the moment they were uncorked, a considerable effervescence, accompanied with a remarkable hissing noise. The cork was several times blown out with a loud report, and abundance of bubbles continued to escape from the fluid for several hours. In decomposing this water accurately by lime water, the precipitate obtained indicated a little more than three times its volume of carbonic acid. The reagents indicated the presence of the different salts that had been dissolved in the water.

The same circumstances took place with the weak Seltzer water; this however yielded a little less gas than the former; yet it produced a similar hissing and effervescence, and one of the corks was blown out.

The strong Spa water had blackened its cork. Some light yellowish clouds were seen floating in it; it was brisk and sparkling, and had a distinct ferruginous taste; it reddened on the addition of nut-galls.

The weak Spa water was brisker and more acidulous than the former; it had less of the metallic taste, and was not so much blackened by the addition of gallic acid. Some light yellowish clouds were also perceived in it.

The gaseous alkaline water which was much less effervescent than any of the former, and had a sweetish taste, contained twice and half its volume of carbonic acid. The presence of the alkali was made conspicuous by every possible reagent; and its power in weakening the acidity, was abundantly well marked, especially when compared to the Seltzer and Spa waters.

The Seidlitz water, besides the properties of a gaseous water, exhibited those of a solution of sulphate of magnesia, or Epsom salt.

The oxygenated, hydrogenated, and hydrocarbonated waters, differed but little either in taste or properties from common water. They produced neither hissing noise, on being uncorked, nor any very sensible effervescence, on coming in contact with air; and, in general, they did not offer any obvious analogy with gaseous waters. They scarcely emitted a few bubbles of oxygen, or hydrogen gas; and they did not produce

upon any reagent, effects sufficiently marked to indicate clearly the presence of the gases with which they had been impregnated by pressure; yet the small portion that they did yield, had undergone no alteration, but retained the characters, the one of oxygen, and the other of hydrogen gas, in a state of tolerable purity.

Finally, the hydro-sulphurated waters, without producing any agitation, or effervescence, appeared a little turbid, and emitted a slightly foetid smell. The nitrous acid, and acetite of lead; clearly indicated the presence of sulphur. The precipitate produced by the first of these reagents, was more distinctly marked in the strong, than in the weak fort.

All the phenomena and characters that have just been enumerated and described, were equally discovered in the principal kinds of the same mineral waters, some months after they had been sent from Geneva to Paris, where they had been kept in cellars; there was this difference however, that the quantity of carbonic acid in the first kind, was sensibly diminished, although not so much as might have been expected, since the stronger fort still contained twice and half its volume of carbonic acid.

SECTION V.

Observations on the Modes of Preparation, and on the Nature of the Waters.

THE general survey of the establishment, the inspection of the apparatus, the communication made by M. Paul himself, of his receipts for the factitious waters, and the examination of these waters, both fresh and old, as prepared by him at Geneva, and at Paris, led the Committee to some observations, which it may be useful to communicate to the Institute: they relate both to the general processes used by the inventor, and to the special nature of each of the mineral waters in particular. The principal object of these observations is to suggest some modifications or improvements of which these artificial liquids appear susceptible, and which may have some influence on their success in the cure of diseases.

1st, Although there can be no doubt, that the machines and processes of M. Paul, enable him to impregnate water with a greater quantity of gas than any of the processes hitherto employed, these waters have constantly appeared, on examination, to contain less gas than the author stated. It should not be inferred from this circumstance, that

that M. Paul does not actually possess the means of condensing in the water, by his compressing machine, as much as 6 times its volume of carbonic acid, and of ascertaining with certainty, the reality of this condensation; but it is certain, that these waters suffer constant and successive losses, either at the moment the cork is applied and sealed in the bottle, or in keeping, or uncorking it; as the rapidity and noise with which the cork is drawn, sufficiently denotes. It must be observed, however, that more elastic fluid is obtained from these waters, by the pump and other ingenious mechanism that the author has constructed for that purpose, than by the processes used by the Committee; but there is reason to believe, that notwithstanding his ingenious contrivance for disengaging the gases from the water, and ascertaining their quantity, still there may be some source of error; since solutions of lime and barytes, uniformly indicate a smaller quantity of these gases*. This observation, however, (the only one the Committee will have to make on the general scheme of M. Paul,) ought rather to convey a more favourable idea of his establishment, as will appear from the following remarks on each kind of artificial water in particular.

2dly, The strong Seltzer water, although appearing to contain, when chemically examined,

* See the Appendix, Note D.

less carbonic acid than it was made to absorb in the process of preparation, is still found to be loaded with a greater quantity of this gas than any of the artificial waters hitherto made. Bergmann, and all the authors that have followed him, mention only a volume of gas, either equal, or a little superior to that of the fluid; whilst M. Paul's waters constantly yielded upwards of *three times* their volume of gas. But this great proportion of carbonic acid, which gives to the superabundant gas such a constant tendency to escape, and to the water such a remarkable effervescent quality, may be regarded as superfluous as to the medicinal properties of the water. Twice its volume of gas would be sufficient to render it superior to any of those that nature affords. Patients do not take in any thing like the quantity of gas contained in M. Paul's factitious water; a great deal of it being disengaged in uncorking the bottles, and a great deal again in pouring out the water and swallowing it. But it must be acknowledged that the brisk and sparkling quality is generally agreeable, and particularly well adapted to some domestic purposes; so that, although it is not indispensable in the medicinal administration of these waters, the author nevertheless, deserves credit for this additional merit. The Committee, however, does not entertain the same opinion with respect to the addition of carbonate of lime and magnesia, in the artificial Seltzer water. They believe

believe with Bergmann, that these earthy salts, without being so noxious as the illustrious professor thought, and without occasioning the obstructions which he apprehended might result from them, cannot at least add any useful quality to this water, and may, perhaps, diminish those which it derives from its other principles*.

3dly, The preparation of the weak Seltzer water, with carbonic acid extracted by heat, was a very happy invention. It is certain that this water has not the same sharpness, and does not occasion the same irritation as is observed in that which is prepared with carbonic acid obtained by effervescence. The two observations on the superabundance of acid, and on the presence of the earthy salts, apply to this kind as well as to the former. It may moreover be observed, that it would, perhaps, be desirable that this water should not contain the hydrogen gas which M. Paul states to exist in it; and as the origin of this gas is well known, he might easily avoid it by substituting in place of his iron cylinder, an earthen one, and for the chalk which he employs, some powdered marble or calcareous spar. The water which he pours into the cylinder, and which he finds so efficacious in facilitating and hastening the disengagement of the carbonic acid, would then no longer give birth to the hydrogen gas above mentioned. But it must be acknow-

* See the Appendix, note E.

ledged, that this remark, although tending to carry a little farther the degree of perfection which this preparation is susceptible of, ought to be considered as of little importance, with respect to the nature and salubrious effects of this kind of mineral water*.

4thly, In both kinds of M. Paul's factitious Spa waters, there always appears a cloudy precipitate of carbonate of iron, notwithstanding the superabundance of carbonic acid, which is contained in these waters, and the exact and careful method by which the iron is added. M. Paul puts into the bottle, previous to the introduction of the salts, and of the gaseous liquid, a quantity of solution of iron in acidulous water, the proportion of which he varies according as he wishes to prepare weak or strong Seltzer water. The precipitation of the iron must, therefore, be owing to the previous preparation of this solution; and it would be very easily prevented either by preparing the ferruginous solution later, or by leaving out the two earthy salts, which are added to no useful purpose. However, notwithstanding this partial precipitation of iron, there remains enough of it to give to the water the metallic taste, the property of blackening on addition of gallic acid, and the medicinal qualities that are known to belong to this class of waters.

* See the Appendix, note F.

5thly, The gaseous alkaline water is prepared with carbonate of pot-ash, evidently for the sole purpose of giving it exactly the same quality as that known under the name of alkaline mephitic water, so much used in England, and so strongly recommended by Dr. Jugenhoutz, in cases of calculus. Yet the natural gaseous alkaline waters are all solutions of carbonate of soda, with excess of carbonic acid. The waters of Vichy, of Bard, and several waters of Puy de Dome and Montd'or, are of that kind. If Physicians should wish to have waters prepared exactly similar to those which we have just mentioned, it would be very easy to M. Paul to introduce that slight modification in his process, by substituting the carbonate of soda to the carbonate of pot-ash. He might, at the same time, continue to prepare the alkaline gaseous water with pot-ash, if it should continue to be found useful in some urinary complaints; but it does not appear at all probable, in the present state of animal analysis, that an alkaline carbonate should possess a solvent power over calculi formed of uric acid or phosphate of lime; and these two kinds of concretions are known to be the most frequent of all.

6thly, Although the Seidelitz water, with which we are acquainted at Paris, does not, by any means, contain a portion of gas approaching to that which is introduced into the waters which M. Paul prepares; this addition, probably recommended

by medical men, cannot be attended with any inconvenience: it would be easy, however, in case it should be found adviseable, to diminish at pleasure the proportion of gas, as also to vary and increase the proportion of sulphate of magnesia, in order to render this water more active and more purgative. Perhaps, also, it will be found proper that M. Paul should add to his factitious Seidelitz water, the small proportion of muriate of magnesia, which has been found in the natural Seidelitz water, and which, considering its sharp and strong taste, seems to deserve being ranked amongst its active principles.

7thly, The preparation of oxygenated water, and the solution of oxygen gas, in twice its volume of water, by means of a strong pressure, is a real and important discovery, both in philosophy and medicine. There is every reason to believe, that it will become useful in several arts; and it may also account for some natural phenomena, hitherto but little understood. This water, however, does not appear to be a true solution of oxygen gas; the gas seems merely to be condensed and retained in it by pressure, so as to escape from it easily, whenever the pressure is either diminished or removed; and it is for that reason, no doubt, that we could not extract from the water even one-third of the quantity which the author states. Although the taste, and other properties of the water thus oxygenated, seem not

to differ from those of common water, it would not be reasonable to raise any doubts on the effects which the physicians of Geneva have obtained from it; which effects they have carefully described in several numbers of the *Bibliothèque Britannique*, while treating of the modern pneumatic chemistry. From the researches which one of the members of this Committee had already made on that part of medicinal chemistry (several years before Messrs. Rollo and Cruickshank, who seem either to have forgotten or to have been ignorant of his previous speculations on the subject), the Committee is persuaded, that water impregnated with oxygen gas, may become one of the most powerful remedies, and most useful resources in the healing art. It will, perhaps, in many instances, supply the place of the acids, the oxyds, and metallic salts, with regard to their oxygenating operation, or, at least, assist and support them in promoting that effect. But this is quite a new field of investigation, where much remains to be done before it is possible to draw any positive conclusions.

8thly, As to the hydrogenated and hydro-carbonated waters, notwithstanding the hopes which the Physicians of Geneva had, with some foundation, conceived of these waters, when they induced M. Paul to attempt their preparation; the trifling effects that have been obtained from them are such as might have been expected from the
small

small quantity of hydrogen gas which they contain, and the extreme weakness with which it adheres to the liquid; this however by no means appears to be a sufficient reason for laying aside these two kinds of artificial waters. Time alone can show what may be expected from their use; and the theory of elastic fluids, in showing, that hydrogen and oxygen are contrasted in their virtues, indicates that their utility should not be despaired of, until their true properties have been carefully ascertained.

9thly, Finally, the sulphurated waters appeared to the Committee to be not sufficiently impregnated with sulphurated hydrogen gas. This gas is united, in this instance, with some pure hydrogen gas, forming only one thirty-second part (in volume) of the weak sort of these waters, and one-fourth of those of the stronger kind. There does not appear to be any advantage in introducing into the water *pure* hydrogen along with the *sulphurated* hydrogen gas; the former, as it is well known, dissolves in water, but very sparingly, and only by means of a considerable pressure, and therefore can but serve to diminish the solubility of the latter, which, of itself, is tolerably soluble. Bergmann proposed to imitate the sulphureous waters by the simple addition of sulphurated hydrogen gas; and no chemist, after him, had ever proposed to associate this with the pure hydrogen gas. At any rate, the proportion of sulphurated hydrogen gas might

be varied according to circumstances, and it could be carried much beyond the limits indicated by M. Paul, whose means however are more than sufficient to fulfil every indication *.

RECAPITULATION AND CONCLUSION.

FAR from wishing to offer the foregoing observations, as objections to the establishment just described, they have only been intended to place in a more meritorious and conspicuous light, the great extent and utility of which it appears susceptible. Those observations ought to prove, at the same time, the high value which the authors of this inquiry set upon the undertaking, and the esteem which they have conceived for the inventor. But that there may remain no doubt in that respect, they will terminate this report by a summary account of the advantages which may be expected from this new manufacture of mineral waters, and of the motives that led them to the conclusions they have drawn.

1st, Since chemistry has determined the nature and proportion of principles (particularly of the gases), dissolved in mineral waters, art possesses all the means of imitating them. The processes of M. Paul show, that he is completely possessed of

* See the Appendix, note G.

those means, and has a perfect knowledge of all the resources that art can afford.

2dly, The new establishment described in this Report, offers a laboratory much superior to any hitherto known; here are no longer seen the narrow means commonly used in chemical laboratories, nor is the operation any longer confined and restrained by the complication of a thousand other experiments, going on at the same time. It is a true PNEUMATIC LABORATORY, a real manufacture, in which the same course of operations, performed with great care and upon a large scale, constantly lead to uniform results.

3dly, To the common, but inadequate processes of ordinary laboratories, M. Paul has substituted a compressing machine, which introduces into the water, not only a quantity of carbonic acid gas three times as great as could be done before, but other elastic fluids also, which had been hitherto considered as totally insoluble.

4thly, The Seltzer and Spa waters prepared in this establishment, are made much stronger, and much superior to those which were formerly prepared in shops and laboratories, and this entirely by means of the new process of compression which Mr. Paul employs for saturating the water with carbonic acid gas. The weak Seltzer water, prepared with carbonic acid evolved by heat, has certainly the advantage of being much less irritating, and therefore much better adapted

to

to certain cases, than that prepared with the same acid disengaged by effervescence, which; in such cases, might be attended with prejudicial effects.

5thly, The oxygenated and hydrogenated waters are acquisitions of considerable importance in the healing art. In Physics and Chemistry; they will afford new means of investigation; and in agriculture, and in the arts, they may perhaps become new instruments equally useful and valuable.

6thly, The Seidlitz waters, and the sulphureous artificial waters, are entirely similar to the natural springs which they are intended to imitate.

7thly, The preparation of the various kinds of medicinal mineral waters, by the methods of M. Paul, is susceptible of modifications and improvements, readily to be obtained. It would be easy, by means of some slight changes in the quantities of the different ingredients, and the management of the processes, to increase, diminish, and otherwise modify their effects.

8thly, The new establishment, considered in a general point of view, offers to the healing art a series of medicinal preparations, that may fulfil in practice a variety of indications of cure; and, with the assistance of a very few other means, prove adequate to the treatment and relief of a great number of diseases.

9thly, The preparation of mineral waters having thus become easy, and being carried on upon a large scale, the indigent sick, and the hospitals of every description, will find, in the products of this pharmaceutical establishment, curative means that they could much less easily have obtained from their natural source, on account of the expence of travelling, or that which necessarily attends the importation of those waters from distant countries.

10thly, Finally, this preparation of artificial mineral waters, carried on upon such an extensive scale, as to supply constantly a great number of individuals, is calculated to create in France a new branch of industry, not only important to the healing art, but also to commerce and national prosperity, by preventing the exportation of considerable sums of money, which, on the contrary, will now be imported for the same object from neighbouring countries.

The Committee, therefore, is of opinion, that the Institute should give the most distinguished approbation to the processes of Mess. Paul and Co. for the preparation of artificial mineral waters, and declare, that they have perfectly fulfilled their intended object of supplying medicine with artificial remedies, that are in many instances EVEN SUPERIOR to those which nature affords*.

NATIONAL

* See the Appendix, Note H.

NATIONAL INSTITUTE 21st Frimaire, the
8th Year, (December 1800.)

(Signed) VAUQUELIN.
CHAPTAL.
PELLETAN.
FOURCROY.
PORTAL.

The Institute approves the Report, and adopts
its conclusions.

26th Frimaire, the 8th Year.

(Signed) CUVIER.

APPENDIX.

NOTES OF THE EDITOR.

NOTE A.—Page 6:

I BEG leave to transcribe here the following declarations of the *Physicians of Geneva*, and of the *Society for the Encouragement of the Arts*, in which those learned and respectable bodies were pleased to express publicly, several years ago, their approbation of my first attempts in the imitation of mineral waters.

DECLARATION OF THE FACULTY OF GENEVA.

“ We undersigned, Physicians of the Faculty
“ of Geneva, declare, that having submitted to
“ our examination the factitious mineral waters
“ prepared by M. Paul, and particularly those of
“ Seltzer and Spa; and having communicated to
“ him our observations on this subject, with a
“ view to assist him in the success and improve-
“ ment of his undertaking: we have seen, with
“ singular

“ singular pleasure, that the means invented and
 “ employed for this purpose, by the said M. Paul,
 “ surpass all the attempts that have been made
 “ hitherto in the imitation of these waters; that
 “ Science, united to industry, has produced in
 “ his hands the happiest effects, since he can
 “ now, with perfect ease, furnish the public with
 “ a constant supply of artificial mineral waters,
 “ stronger and more energetic than the same
 “ waters, when issuing from the laboratories of
 “ Nature; so that we can positively assert, that
 “ M. Paul, by his laudable efforts, has suc-
 “ ceeded in rendering himself equally interesting
 “ to Physicians, and useful to humanity, in the
 “ cure of diseases.”

Geneva, 26th August, 1796.

(Signed) SOLOMIAC, M. D.

and Senior of the Faculty.

VIEUSSEUX, M. D.

ODIER, M. D.

VIGNIER, M. D.

DUNANT, M. D.

MANGET, M. D.

MIROGLIO, M. D.

BUTINI, Jun. M. D.

VEILLARD, M. D.

DECLARATION OF THE SOCIETY FOR THE ENCOURAGEMENT
OF THE ARTS:—COMMITTEE OF MECHANICS.

“ We undersigned declare, that having, at M.
 “ Paul’s request, attended at his house, in order
 “ to witness the process, by means of which he
 “ impregnates his factitious mineral waters with
 “ carbonic acid gas; and having examined his
 “ several apparatus minutely: we have found
 “ them constructed upon excellent principles,
 “ and capable of condensing in water, quantities
 “ of this elastic fluid, superior to those that are
 “ contained in natural mineral waters, however
 “ carefully preserved. The energy of those appa-
 “ ratus can be varied at pleasure; and their
 “ action is such as to impregnate rapidly a very
 “ considerable quantity of water. They are also,
 “ from their nature, equally applicable to the
 “ condensation of any other elastic fluid with
 “ which water can be impregnated, thus supply-
 “ ing the art of healing with new means of cure,
 “ and opening to Physicians and Chemists a
 “ new and interesting field of observation.

“ M. Paul has shewn himself, in the construction
 “ of these apparatus, deeply conversant with me-
 “ chanics, and natural philosophy; and we have
 “ observed, with great satisfaction, that this dis-
 “ tinguished artist has had chiefly in view, for a
 “ long time past, in his successive labours, and in
 “ the

“ the gradual developement of his talents and
 “ industry, the relief of suffering humanity; and
 “ we seize with pleasure this opportunity of ex-
 “ pressing to him our distinguished approbation.”

Geneva, 27th August, 1796.

(Signed) M. A. PICTET, Professor of Na-
 tural Philosophy, and President
 of the Committee of Mechanics,
 of the Society for the Encourage-
 ment of the Arts.

ODIER, M. D. Member of the
 same Society.

BUTINI, Jun. M. D.

NOTE B.—Page 9.

The observations here alluded to, were published by Dr. Odier, Professor of Medicine at Geneva, in the 8th and 10th volumes of the *Bibliothèque Britannique*, annexed to an account of Dr. Rollo's late publication on the treatment of Diabetes and Syphilis, and to that of Mr. Cavallo's work on Factitious Airs. The name of Dr. Odier, and the most justly deserved reputation of the publication in which these observations are recorded, induced me to translate them here verbatim.

“ To the methods of oxygenation and de-oxygenation, mentioned by Dr. Rollo, (says Dr. Odier,

Odier, *Bibliothèque Britannique, Sciences & Arts*, vol. viii.) we must add another, a very simple one, which we have employed for some time past at Geneva with success. I mean the gaseous waters prepared by M. Paul. I have already mentioned them in this journal, (vol. vii.) and promised to speak of their effects as soon as they should be sufficiently ascertained by experience. I hasten to keep my word, in order to facilitate the observations that other practitioners may make on this subject.

“ The oxygenated waters, which contain about half their volume of oxygen gas, are perfectly pure in every other respect. This gas is not incorporated in the water, by means of any basis, but merely by powerful compression. It is therefore necessary, when the waters are used, that they should be constantly kept in bottles well corked, the bottle being reversed upon the cork, in a pot of water; and it should be opened only at the moment of using it, when they should be drank off as rapidly as possible, one glass at a time, carefully corking the bottle between each glass. With these precautions, I have found that this remedy, (which is far from disagreeable, the waters being without any taste whatever), restores the appetite and strength, promotes the secretion of urine, allays spasms of the stomach, particularly when they are accompanied with hysterical
 G symptoms,

lymptoms ; and prevents their return, especially if the fits are periodical.

“ I attended some time ago, the mother of a family, 40 years of age, subject for many years past to hysterical fits, which had lately returned with increased violence, in consequence of great mental emotion. They began with a cramp in the stomach, accompanied with a tightness in the throat, suffocation and contraction of her limbs. This state, which was totally exempt from fever, lasted with all its violence about an hour, after which the symptoms gradually abated, and left the patient with no other sensations than a sort of general uneasiness, which remained for some hours. The next day she was perfectly well ; but the following day, exactly 46 hours after the commencement of the preceding attack, it returned with the same violence, the same symptoms, and in the same manner.

“ She was in her third fit, when I was called in ; I at first gave her the bark in large doses, 4 days successively, without effect. I afterwards tried the *CARDAMINE PRATENSIS* a remedy first recommended by Sir George Baker ; and from which I have seen very good effects in nervous disorders. It failed in this case, though the dose administered was an ounce a-day. At length I used the oxygenated waters, in doses of a glass every two hours, and from the first bottles the remedy succeeded
the

the fits returned no more, and the patient has been in good health since.

“ Another mother of a family of the same age, and nearly the same constitution, was attacked lately by a bilious fever, during the course of which she had several fits of hysterics, which manifested themselves by spasms in the stomach, tightness of the throat, complete extinction of voice, with a sensation of suffocation, great anxiety, involuntary tears, &c. These fits at first recurred at irregular periods. I prescribed the oxygenated waters, but they produced some symptoms of dysuria, which obliged me to suspend the use of them. A few days afterwards, this effect having ceased, and the fits having become periodical, returning regularly every 18 hours, and having resisted very powerful anti-spasmodics, I had again recourse to the oxygenated waters, which now succeeded perfectly, and prevented any return of the paroxysms. The dysuria, which these waters are apt to occasion, again returned, but not till after the patient was cured; and as she then only took the waters by way of precaution, the use of them was discontinued without inconvenience.

“ I shall not enter at present into any further detail of cases. I have seen several analogous instances in which the oxygenated waters have done great service. It appears to me, upon the whole, that they may be ranked amongst the number of good antispasmodic tonics. I have seen them

succeed extremely well in the case of a return of melancholy, which had before been cured by the black oxyd of manganese, which remedy had afterwards failed. I have known also a dropfical case, in which they were attended with astonishing diuretic effects. But they sometimes irritate the urinary passages, and even the intestinum rectum, so much as to produce accidents of dysuria, tenesmus, sanguinolent stools, &c. I have witnessed a singular effect from these waters, that I consider as being of the same nature. I was called in consultation, the 21st of last March, in the case of a girl of eleven years of age, who after the small-pox had a jaundice, which was succeeded by hysterical affections, which returned frequently, and manifested themselves by violent cramps in the stomach, accompanied by suffocation, &c. Several antispasmodics had been tried without effect. I advised the oxygenated waters. They had a complete success, and prevented at once the return of the paroxysm; but during the first three days, the young patient complained of a sensation of extreme cold in making water, as if her urine was frozen. When I was informed of this singular effect, I was desirous of examining the temperature of the urine by the thermometer, but it was too late; the symptoms had ceased, and from that time the patient has enjoyed good health. It is probable, that this sensation of coldness was nothing more than a slight irritation, similar to

that

that which occasioned the dysuria. These accidents, however, are not lasting; and I only mention them to put others in the way of justly appreciating the manner in which these waters act.

“ I do not know whether I am mistaken; but it appears to me, that these oxygenated waters might be used in bleaching linens, with much more ease and advantage, than the oxygenated muriatic acid, from which so much use has been derived for the same object. It would not be difficult to the talents of the ingenious artist, who has discovered the method of preparing them on a small scale, to give a greater extension to his processes, and to make these waters flow as a river, which watering our fields, would powerfully assist our manufactures of printed linens, and revive amongst us a branch of industry of considerable importance.

“ The hydrogenated waters, which contain about one-third of their volume of hydrogen gas, have no particular taste, and require, in being used, the same precautions as the oxygenated waters. They have not hitherto appeared to me to have any very decisive effects. I have employed them, with tolerable success, in cases of fever, proceeding from, or accompanied by, inflammatory irritation. They have almost always, in these cases, evidently diminished the frequency of the pulse; but this effect, which would be very important if it was durable, never lasted long. They have
also

also succeeded in abating, for some little time, the pains of dysuria, and thereby facilitating the evacuation of urine. They have also sometimes procured sleep; but, upon the whole, I have not seen yet any cure performed by their means, and the good effects which patients experience from the first bottles, are little or not at all sensible after a few days. I have heard, however, that they had effectually removed spasmodic disorders, which had resisted other remedies.

“ I may say as much of the hydro-carbonated waters, which do not appear to me to differ essentially from the hydrogenated waters, or to be superior to them in efficacy. It is singular, that the hydro-carbonate is not discoverable in the water by any taste, provided they are carefully prepared, so as to prevent a taste of empyreuma, which they easily contract.

“ The hydro-sulphurated waters, which are prepared by impregnating water with hydrogen gas, mixed with one sixty-fourth part of hepatic gas, have a smell and taste of rotten eggs, which makes them resemble the sulphureous thermal waters. I have employed them, with more decided success than the simple hydrogenated or hydro-carbonated waters, in catarrhal fevers, in consumptions, in old and inveterate coughs. But I have not yet had the good fortune to derive permanent effects from them, whether it is because the remedy being disagreeable, it is difficult to
continue

continue it long enough to obtain any considerable advantage; or whether, because it is naturally less efficacious than would at first have been imagined; or, in short, whether it may not be, that the waters are too weakly impregnated with the principal gas which distinguishes them from the other mephitic waters. They might perhaps be employed to advantage, either internally, as diaphoretics and solvents, that is to say, as favourable to the absorption of the solid parts, (I have seen, in this respect, some good effects from them, though temporary); or externally, in the form of lotions, in herpetic disorders of the psoric kind.

“ I have not yet employed them in this manner; but I presume, that to render them useful, by external application, it is necessary that they should be much stronger, which might be very easily effected.”

In the other article above mentioned, (Bibliothèque Britannique, Sciences & Arts, vol. x.) Dr. Odier expresses himself as follows:

“ I beg leave to take this opportunity of recommending to the attention of Physicians, a mode of oxygenation, much more convenient than that which is obtained by the pneumatic method. I mean the oxygenated waters, which we continue to use in a very extensive and successful manner.

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“ 1st, We every day witness their good effects, in cases of spasms in the stomach and intestines, and especially those that attend hysterical affections, and proceed from debility, rather than from plethora, or any irritating cause. I cured, by means of these waters, a Spanish lady, from 25 to 30 years of age, who had been for a length of time daily attacked with violent spasms, which were originally brought on by strong emotions of mind, and afterwards considerably increased by fatigue, and continual vomitings, which she had suffered in a sea voyage. All the known antispasmodics had been used without success; at length the oxygenated waters were tried, which soon produced a complete cure.

“ 2dly, These waters have been found useful in affections of the chest, of an asthmatic, rather than of a consumptive nature. I saw a woman of 55 years of age, who had been subject for many years past to difficult respiration, attended with occasional fits of coughing and suffocation, take these waters, and derive a relief from them, which no other remedy had been able to afford. I knew likewise a gentleman about 50, rather of a weakly constitution, who, in consequence of a catarrhal fever, had suffered for a long time, from a weakness in the chest, so that the least effort of voice fatigued him extremely, an inconvenience he felt the more severely, being professionally
obliged

obliged to give lessons, when he could neither speak nor read aloud, without extreme fatigue. He had a constant sensation of cold, numbness, and weakness in the legs and thighs. After having unsuccessfully tried several other remedies, I at length used the oxygenated waters, which answered perfectly well, and procured him very considerable relief.

3dly, "The oxygenated waters have also appeared to me very useful in cases of weakness and lingering convalescence, after febrile diseases; and when the patient, without having any local complaint, found it difficult to regain his strength, his appetite, and ordinary spirits. I have taken them myself after an ague, which had weakened me considerably, and I derived very good effects from them.

4thly, "They have succeeded extremely well as diuretics, in cases of anasarca, accompanied with oppression and livid countenance. One of my colleagues attended a patient, labouring under a disorder of this nature, who had taken several remedies without effect, and whom the oxygenated waters cured as it were by enchantment, by producing an abundant evacuation of urine. This cure, which was effected several months ago, has proved permanent.

"When I began to use the oxygenated waters, I observed that, with some patients, it brought on distinct symptoms of dysuria. I have since found,

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however, that this remedy seldom produces such an effect; and, on the other hand, I have sometimes successfully used the hydrogenated waters to allay this symptom.

“ However, neither the hydrogenated waters, nor the carbonated, nor even the hydro-sulphureous, have hitherto appeared to me efficacious remedies in those cases, in which they have been used. The oxygenated waters alone have completely answered the hopes we had conceived of them, and that to such a degree, that M. Paul has already disposed of a considerable quantity of these waters. They are contained in bottles of the capacity of about one pint, which, by the means of compression, invented by this ingenious mechanic, are impregnated with half their volume of pure oxygen gas. Patients take one or two of these bottles in the day. I consider this remedy as a valuable acquisition, that will, no doubt, prove permanent in practice. I am far however from thinking, that we have yet any clear notion of the manner in which it operates. Does the oxygen actually pass into the chyle, and from hence into the blood? Or does it act merely on the stomach, and the intestines? Its effects appear so quick, that I should be rather inclined to adopt the latter opinion. In this point of view, there would be but a very distant connection between this mode of administering oxygen, and the oxygenation of the blood by the lungs. But such is
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the origin of most discoveries. We seek for one thing, and find another."

NOTE C.—Page 16.

In the month of July, 1800, the same year in which this Report was read before the Institute, another Report on the same subject was presented to the SOCIETY OF MEDICINE OF PARIS, the substance of which perfectly coincided with the former. But from the account this Report gives of the formulæ, employed in the fabrication of the waters, it will be seen that some slight changes had already been effected in the formulæ, in consequence of the hints suggested in the Report to the Institute. In the Seltzer and Spa waters, the carbonate of lime had been suppressed; and, on the other hand, the following new varieties of waters had been added, either to be drank, or used as baths:

Water of Vichy.

Carbonic acid by effervescence, twice its volume.

Carbonate of Lime, 2 grains

Carbonate of Magnesia, . . . $\frac{1}{2}$ gr.

Carbonate of Iron, $\frac{1}{3}$ gr.

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Carbonate

Carbonate of Soda,	24 grs.
Sulphate of Soda,	6 grs.
Muriate of Soda,	4 grs.

Water of Buffang.

Carbonic acid by effervescence, 3 times its volume.

Carbonate of Soda,	6 grains
Carbonate of Iron,	$\frac{1}{3}$ gr.

Water of Vals.

Carbonic acid by effervescence, 3 times its volume.

Muriate of Soda,	13 grains
Sulphate of Iron,	$\frac{1}{2}$ gr.
Sulphate of Alumine,	$\frac{1}{2}$ gr.
Carbonate of Iron,	$\frac{3}{4}$ gr.

Water of Contreaeville.

Carbonic acid by effervescence, one-twelfth part of its volume.

Sulphate of Lime,	6 grains
Carbonate of Lime,	4 grs.

Water of Balaruc.

Carbonic acid by effervescence, twice its volume.

Calcareous

Calcareous Earth	4 grains.
Muriate of Soda	12 grs.
Carbonate of Pot-ash	4 grs.

Water of Plombières.

Carbonic acid by effervescence, one-twentieth part of its volume.

Sulphate of Lime	3 grains
Carbonate of Lime	2 grs.
Sulphate of Magnesia	1 gr.

Water of Barége.

This water contains in each bottle 10 or 12 drops of the following preparation :

Common water	8 ounces
Sulphate of Soda	$\frac{1}{2}$ dram
Carbonate of Soda	2 ounces
Muriate of Soda	2 drams
Oil of Petroleum	12 drops.

The Report of the Society of Medicine, from which the foregoing statement is extracted, concludes as follows :

“ From the report you have just heard, we propose to the Society to give to the establishment of Messrs. Paul and Co. for the preparation of artificial mineral waters, the most authentic approbation, acknowledging the excellence of their methods, the perfection of their products, “ and

“and the utility which both national interest and
“the health of Citizens may derive from their
“enterprize.”

(This Report is signed)

PELLETIER,
FOURCROY,
P. JOSSE,
DELUNEL,
LAFISSE.

NOTE D.—Page 23.

The quantity of gas condensed in the water, in the first instance, is exactly indicated during the operation by the nature of the process itself. As for the deficiency of gas observed by the reporters, on examining the contents of the bottles, they have partly accounted for it themselves. I have only to remark, that in order to extract all the gas from the water in which it has been condensed, I have found that the combined assistance of a boiling heat, and of the pneumatic pump, were absolutely required; and the apparatus alluded to in the report, is adapted to this double purpose. But even with the assistance of this apparatus, I have reason to believe that a portion of gas always remains intimately united with the water, in which it is detained, partly by the earthy ingredients, partly, perhaps, by the water itself.

NOTE

NOTE E.—Page 25.

I have occasionally tried to suppress the earthy carbonates, in consequence of the objection suggested, in the Report on the supposed inutility or noxious effect of these salts. But several medical men having had reason to suspect that the waters were not always so effectual after this suppression, I shall continue to add these salts whenever physicians shall not think proper to order their suppression.

NOTE F.—Page 26.

The reason why an earthen cylinder has not, in this operation, been preferred to an iron one, is, that the former, from it's porous texture, particularly when exposed to a strong heat, cannot answer the purpose near so well as one made of cast iron. But care is taken that the cylinder be previously so oxydated as to be very unfit for decomposing water, and the very small portion of hydrogen that may still be disengaged, has never been found to alter in the smallest degree the good qualities of the water. Perhaps, upon further examination, this supposed portion of hydrocarbonate may be found to consist partly of the gaseous oxyd of carbone, which has lately attracted the attention of Chemists. This, however, is but a
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mere conjecture, which I shall take the earliest opportunity of verifying by experiment.

NOTE G.—Page 31:

Some sulphureous or hepatic waters are found in Italy, which appear to be considerably stronger than any of those that are found in other parts of Europe. In the month of August, 1801, the Medical Society of Paris gave, in their journals, an account of a work of considerable length, soon to be published, on the mineral waters of Naples or its environs. The author of this Treatise (which I understand is now printing) is ARRU-MONELLI, Professor of Physiology, and Physician to the chief hospital of Naples. It appears from his account, that Nature has brought together, in that particular spot, all the strongest remedies of this sort that she has ever been known to produce; the sulphureous waters containing (according to the analysis given in the extract of the work just quoted) no less than *once and three quarters* its own bulk of sulphurated hydrogen, with *once and a half* its bulk of carbonic acid gas. The chalybeate waters of Naples seem also to contain a much larger proportion of iron and carbonic acid gas, than any of the mineral waters hitherto analysed.

The Medical Society gave, in the report just quoted, a very favourable account of Professor Attumonelli's Work.

NOTE H.—Page 34.

As it may be interesting to the Reader to have an opportunity of comparing the opinion delivered in this Report, by the French philosophers, on the imitation of mineral waters, with that of the latest English medical authors on the same subject, I shall transcribe here the following passage from Dr. SAUNDERS's valuable work on the MEDICINAL EFFECTS OF MINERAL WATERS, in which he has pointed out in the fullest manner, both the advantages that may result from the artificial imitation of those waters, and the difficulties, which, in some instances, we may still encounter in attempting it.

“ The composition of the most celebrated mineral waters having been known by accurate analysis, several ingenious men have endeavoured to confirm their experiments by synthesis; and to produce, by artificial means, a compound, in all respects similar to the natural preparation. To
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this too was added the additional motive of being able to supply the want of the natural waters, in places, and at times when these could not be procured. The illustrious Bergman, in his excellent treatise on mineral waters, has given very good ideas on the method of preparing them artificially; but some of the processes which he proposes, are imperfect, and liable to objections. Where the water to be imitated is only a solution of some neutral salts, such, for instance, as the Epsom, Sedlitz, or Sea water, all that it is necessary to know, is the proportion in which they are contained in the natural spring; but the processes of nature are not always imitated with so much ease. A greater difficulty lay in the way, which was, that of impregnating water with gaseous substances to as complete a saturation, as is found in some of the most powerful mineral springs. This every chemist knows to be a very difficult object to attain, and impracticable with any of the more common apparatus now in use for such purposes; but, under particular management, it has been attained, and some of the specimens of artificially carbonated water that are to be seen, appear fully to equal in this respect the natural waters of Pymont or Seltzer. The saline and chalybeate principles may also be easily added, and the imitation will be complete for all medical purposes.

“ These artificial compositions have defects as well as advantages. With regard to the former, we

we may observe, that it is always difficult to hit the same point of saturation with gas, and with the substances which the gas is to dissolve; and this is particularly the case with every degree of saturation below the highest. Thus then, these medicines will not be so constantly the same as the natural springs; for uniformity of composition is a very conspicuous feature in almost every one of these. However, as it is generally the *defect* of the natural waters to be too weak in these active substances, and as no material inconvenience appears often to arise from an excess of these gases, it is probable that with tolerable caution, these substitutes might be generally adopted, if requisite.

“ There are some kinds of chemical mixture, however, which art has not been able to imitate: the suspension of siliceous earth in water, a curious and wonderful phenomenon in the history of many of the thermal springs, is a striking example of this. If siliceous earth, apparently so inert and inactive on the body from its great difficulty of solution, should ever be found to possess any medicinal properties, this will form a marked difference between the natural and artificial medicated waters. Perhaps the super-sulphurated waters of Aix, combined as they are with soda and with a high degree of heat, would exercise all the powers of the best chemist to imitate with success. Several other combinations might be pointed out, in which,

if *perfect* accuracy of resemblance were required, we should still find the imperfection of art. Again, there is another case in which the natural water has a great advantage over the artificial; and this is, in some of the very compound thermal springs that are used for bathing as well as for a drink. It must be more difficult at all times to prepare a hot than a cold artificial water; and for the purposes of the bath, much advantage is gained by having a large body of water, as at Bath, Aix, and the like, where the patient can move his limbs about freely when immersed, and is surrounded with an atmosphere of steam, mixed with the volatile gaseous contents of the water, and where the heat is kept up much more permanently and uniformly.

“ On the other hand, some peculiar advantages may be gained by the artificial preparation of medicated waters. Several of the most valuable natural springs contain substances which are either useless or positively detrimental. Pyrmont water, for instance, contains thirteen grains in the pint of calcareous salts, which render it very hard; and hence it may certainly prove inconvenient to some constitutions. Other neutral waters contain so little of their most active ingredient, as to require often an inconvenient bulk of liquid to produce the desired effect; as for example, where Scarborough or Epsom water are used as purgatives. All these defects may be remedied in the artificial preparation,

preparation, by leaving out the useless and noxious matter, and encreasing that in which the proper medicinal virtue resides. Art likewise can prepare out of the same materials, new compounds, which would be considered as valuable natural treasures, were such found. Of this kind, I should reckon a moderately dilute solution of a neutral salt, (vitriolated magnesia for instance) fully saturated with carbonic acid. This makes a very valuable addition to its powers as a medicine, from the known operation of this gaseous acid in quieting irritation of the stomach, and rendering the surface of the body more cool and perspirable; and besides, it powerfully corrects the nauseous taste, which is in many instances a material objection to the neutral salts, especially to a daily use of them as a gentle evacuant and alterative.

“ One more advantage I would mention, which the artificial preparation of these medicines would promise, and this is, that of introducing much more simplicity in their composition than nature employs, and by this means we may be materially assisted in forming precise ideas of the operation of every part of these important class of remedies, which the reader will readily see is a great object to be desired by the philosophical enquirer into the powers of medicine. Every one who examines into this subject, must be struck with the great inaccuracy and confusion of ideas that pre-

vail in the description of the operation of mineral waters, and the great similitude of effect ascribed to very different species of this large and heterogeneous class of bodies. It has been my object in the preceding pages, to attempt in some degree to introduce more precision in investigating the powers of these bodies; but the subject can never be fully canvassed, till we are in possession of a greater number of facts founded on experiment; and to promote this desirable end, the assistance of art in imitating the processes of nature, may be called in with every prospect of advantage. In this view, therefore, the study of the method of preparing mineral waters may be recommended to the medical enquirer as an interesting object of investigation.

“ For the practitioner, who entertains a decided preference for the medicated waters which nature presents, we may suggest the convenience of occasionally mixing different kinds of the simple waters, in order to obtain the effects of some of the more compound, which may not be at all times procured. Thus a Spa or Pyrmont water, mixed with that of the Sea or Epsom, will make a good imitation of the Cheltenham or Scarborough spring, according to the proportion used; as the one furnishes in abundance the carbonic acid and the iron, and the other, the neutral purgative salt; and each of these contain so much of their active ingredients as to bear dilution, and yet to retain considerable

considerable efficacy. The synoptical table, which is added to the chapter on the particular waters, will, it is hoped, afford some assistance in this object.

“ There is nothing more gratifying to the physician, who considers the healing art in its true light, that of an experimental science, than to be able to add to the general stock of professional knowledge, information which is to be afforded by the assistance of a collateral science. Of these, none is more intimately connected with medicine, by a community in many of the objects, than chemistry; and the aids which this science furnishes, are constantly encreasing, on account of the rapid accumulation of experimental knowledge. An enquiry into the nature and right application of mineral waters, is certainly not one of the least important objects of physic; since these are remedies that have been at all times peculiarly favourites with the public, and have deserved, from their real efficacy, much of the esteem in which they have been held. The substances concerned in the composition of these waters, are such as come particularly under the accurate and distinguishing eye of modern chemistry, and admirably illustrate some of its most beautiful discoveries. They have engaged the attention of the ablest chemists for many years in various countries, and the importance attached to these enquiries, has
abundantly

abundantly repaid the labour and difficulty of the research.

“ Impressed with the idea, that the science of chemistry has done more to illustrate this, than almost any other class of natural substances that are used medicinally, it has been my wish in the foregoing pages to lay before the public a general view of our present state of knowledge on this subject; in order to ascertain, with some precision, the practical advantage to be derived from these facts. Viewing, with some regret, the apparent slight which has been thrown upon these enquiries by some, whose professional knowledge attaches much weight to their opinions, I have endeavoured to clear away some causes of error, arising from too partial and confined a view of the subject; in order that the leading features of medical chemistry, attached to these enquiries, may be rendered more conspicuous; and my object in undertaking this work will be answered, if these pages will at all contribute to the advancement of the healing art.”

THE END.





